# Impact of Electrode Contact Site on the 12-Lead ECG Synthesized from Wrist-Worn Device Signals

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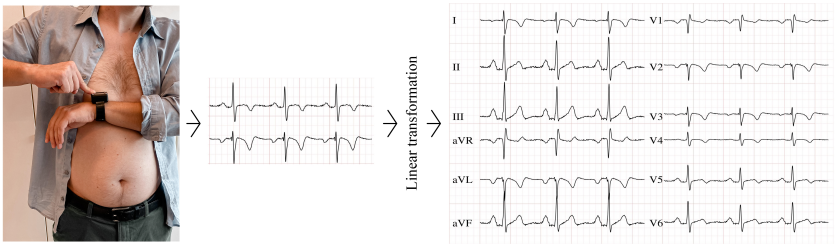
**Introduction:** With the availability of wrist-worn devices capable of simultaneously capturing two ECG leads, the possibility opens to synthesize a 12-lead ECG, thereby facilitating interpretation. Accordingly, this study explores the impact of an electrode contact site on the accuracy of the synthesized ECG.

**Methods:** Twenty-three patients with cardiovascular diseases (acute myocardial infarction, right bundle branch block, etc.) and 32 healthy participants were involved in the study. To acquire ECG lead I, one electrode of the wrist-worn device was touched with the index finger of the opposite hand, while the other lead was obtained by contacting the electrode on the strap with a specific part of the body. Participants were instructed to touch areas on the body corresponding to the standard electrode placement sites for acquiring leads V3 and V5, as well as the abdomen. The 12-lead ECG was synthesized through a linear transformation of two leads from a wrist-worn device using personalized and universal transformation matrices.




Synthesizing a 12-lead ECG from two wrist-worn device signals

**Results and conclusion:** The lowest RMS error between the reference and synthesized ECG was achieved for leads I and V1, regardless of the contact site from which the non-standard ECG was acquired. Among patients with cardiovascular disease, the RMS error ranged from 0.028 mV to 0.046 mV for lead I and from 0.024 mV to 0.036 mV for lead V1 when using a universal transformation matrix. The leads V2, V3, and V4 were synthesized poorly, as indicated by the twofold increase in the error. The contact site on the abdomen consistently yielded the lowest error for patients with cardiovascular disease.